Feasibility Study Supplement: Detailed Evaluation of Alternatives for the Eagle Zinc Company Site, Hillsboro, Illinois

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1 Introduction

This memorandum is the second of two technical memoranda that supplement the results of a feasibility study (FS; ENVIRON 2006b) conducted of the former Eagle Zinc Company Site. ENVIRON International Corporation prepared the FS report on behalf of the Eagle Zinc Parties as part of the remedial investigation (RI)/FS for the site. The RI/FS was conducted pursuant to the statement of work contained in the December 31, 2001, Administrative Order on Consent between the Eagle Zinc Parties and the United States Environmental Protection Agency (USEPA).

The 132-acre Eagle Zinc site is located in a mixed commercial/industrial and residential area in the northeastern part of Hillsboro, Illinois. Buildings cover 10 to 15 percent of the site surface. Other principal features include raw material and residual material stockpiles (ENVIRON 2004a). A summary of site conditions can be found in the RI report for the Eagle Zinc site (ENVIRON 2004a, 2006a).

In the first supplemental technical memorandum CH2M HILL, on behalf of USEPA, updated the FS remedial alternatives to reflect the conclusions of additional human health and ecological risk assessments conducted for the site. In addition to the remedial alternatives, it included revisions to the following FS components:

- Applicable or relevant and appropriate requirements (ARARs) of environmental laws and regulations
- Remedial action objectives (RAOs)
- Preliminary remedial goals (PRGs)

This second memorandum provides a detailed evaluation of the revised remedial alternatives.

2 Description of Remedial Alternatives

2.1 Alternative 1—No Action

The objective of Alternative 1 is to provide a baseline for evaluation of remedial alternatives, as required by the National Contingency Plan (NCP). Under Alternative 1, no additional remedial actions would be conducted at the site to control the continued release of and exposure to contaminants. There would be a risk to industrial and construction workers from direct contact with the residue piles and soil in the southwestern area of the site. Chemicals would continue to be present in groundwater above the PRGs due to leaching, and groundwater discharge to surface water would continue to cause surface water PRG exceedances. Sediment would remain as a potential risk to ecological receptors.

2.2 Alternative 2—Immobilization, Regrade, and ARAR-Appropriate Cover

The main components of Alternative 2 are shown in Figure 1 and are as follows.

2.2.1 Institutional Controls

Restrictive covenants would be added to the property deed to notify future owners that residue and soil present at the site pose risk to human health and the environment. The current restrictive covenant that prevents use of onsite groundwater would be maintained. Future excavation activities would require a health and safety plan and disposal of excavated material in accordance with applicable laws and regulations. A site development plan would specify future industrial development restrictions; for example, that an ARAR-appropriate cover is required for exposed residue not otherwise covered by facilities such as buildings, roadways, or parking lots.

2.2.2 Monitoring and Assessment

Monitoring of groundwater, surface water, sediment and habitat quality would be performed annually. The following locations would be sampled for analysis of inorganics:

- Monitoring wells G-102, MW-6, MW-7, and MW-8 (lead, cadmium, manganese, and zinc)
- Surface water and sediment locations WD-7, WD-8, WD-9, and ED-13 (aluminum, cadmium, cobalt, copper, iron, lead, nickel and zinc)

Habitat quality would be assessed in a 1-day annual site visit by a qualified scientist.

2.2.3 Consolidation and ARAR-Appropriate Cover of 12 Residue Piles and Soil Area Greater Than PRGs

Twelve residue piles (CPH-5, CPH-6, NP-13, NP-15, NP-16, RCO-5, RCO-10, RRO-12, RR1-1, RR1-2, RR1-4, and RR2-11) and the area of soil around sample location A1-3-S1 exceeding industrial direct contact PRGs would be consolidated onsite into one or more areas and covered with at least 1 foot of soil and revegetated. The in situ volume of residue and soil to be consolidated is estimated to be 42,000 yd^3. The location and dimensions of the

consolidation area would be determined during design and would be consistent with future site development.

The area chosen for the consolidated residue and soil would be cleared, grubbed, and rough graded before placement of residue and soil. The final slopes of the residue would be designed to promote runoff while minimizing the potential for erosion. The specific soil type of the cover would also be selected in design, but it is assumed for cost estimating purposes that it would include 0.5 foot of low permeability clay combined with 0.5 foot of topsoil. The soil cover would be revegetated to reduce infiltration and erosion.

For cost estimating purposes, it is assumed that the soil and residue would be consolidated into a 5-acre area in the southwestern part of the site. This results in a 6-foot thickness of residue and soil beneath the cover. The southwestern area was chosen because it overlies the area of groundwater where cadmium and zinc exceed groundwater standards. The vegetated 1-foot soil cover and controlled surface water flow away from the site is expected to reduce infiltration through the residue, thus helping to reduce the exceedance of groundwater standards and potentially surface water standards.

2.2.4 Onsite Immobilization of Residue Piles NP-14, RR1-3, and MP1-21

Three residue piles (NP-14, RR1-3, and MP1-21) would be treated using immobilizing agents to meet the Synthetic Precipitation Leaching Procedure (SPLP)-based PRGs for cadmium, lead, and zinc and consolidated into one area. The treated residue would be covered with at least 1 foot of soil and revegetated. Immobilization agents would prevent further leaching of cadmium, lead, and zinc to the groundwater. The location and dimensions of the consolidation area would be determined during design and would be consistent with future site development.

Specific immobilization agents such as phosphate, sulfide or cement-based would be determined during design. Bench-scale tests of the residue would be performed using a variety of agents. The most cost-effective immobilization mix that prevents leaching of contaminants at concentrations exceeding groundwater standards would be chosen.

It is assumed that the area for consolidating the treated residue would be located in the same area of the consolidated residue piles posing only direct contact risks. The volume of the residue piles were determined in FS (ENVIRON 2006b). The location of each would be surveyed and recorded as part of the institutional controls for the site.

2.3 Alternative 3—Regrade, ARAR-Appropriate Cap and Cover

The main components of Alternative 3 are shown in Figure 2 and are as follows.

2.3.1 Institutional Controls

Same as Alternative 2.

2.3.2 Monitoring and Assessment

Same as Alternative 2.

2.3.3 Consolidation and ARAR-Appropriate Cover of Residue Piles and Soils Exceeding PRGs

Same as Alternative 2.

2.3.4 ARAR-Appropriate Cap for Residue Piles NP-14, RR1-3, and MP1-21

The three residue piles (NP-14, RR1-3, and MP1-21) would be consolidated into one area and capped with an ARAR-compliant low-permeability cap to minimize infiltration through the residue, promoting runoff and evapotranspiration.

The area for consolidation is assumed to be in the southwestern part of the site adjacent to the area used for consolidation of the remainder of the residue piles. The volume to be consolidated and capped is estimated to be 2,100 yd^3. Assuming an average residue thickness of 5 feet, the cap area would cover about 0.25 acre. The cap cross section would be determined during design but is assumed for cost estimating purposes to include the following layers from the surface downward:

- 0.5 foot of vegetated topsoil
- 1.5 foot of fill for freeze-thaw protection
- Separation geotextile
- 1-foot sand drainage layer
- 40-mil HDPE liner
- 2 feet of low permeability clay soil

2.3.5 Regrade and ARAR-Appropriate Cover over Southwest Area

The 20-acre area in the southwestern part of the site would be graded to reduce erosion and promote runoff and covered with at least 1 foot of soil to establish a vegetative cover. The area currently is covered with residue at thicknesses ranging from about 5 to 21 feet. Some areas, particularly along the southwest pond and draingeways, have steep slopes with evidence of erosion. Much of the area is unvegetated residue. The object is to reduce erosion of residue and reduce infiltration and leaching of chemicals of concern (COCs) to groundwater, which could potentially migrate to offsite surface water. This area overlies the area of groundwater concentrations exceeding cadmium and lead PRGs and is believed to be the main area contributing to surface water exceedances of PRGs.

Initially the area would be grubbed to remove existing vegetation and grading to establish the design slopes ~~would be performed~~. It is assumed these would be 2 percent slopes, though steeper slopes may be necessary in portions of the site. If necessary, some of the residue may be redistributed further away from drainage-ways and the southwest pond. After slopes are established, a 0.5-foot-thick layer of low-permeability clay soil would be placed to reduce infiltration. A 0.5-foot topsoil layer would be placed above it and seeded.

2.4 Alternative 4—Offsite Disposal, Regrade, and ARAR-Appropriate Cover

The main components of Alternative 4 are shown in Figure 3 and are as follows.

2.4.1 Institutional Controls

Same as Alternative 2.

2.4.2 Monitoring and Assessment

Same as Alternative 2.

2.4.3 Consolidation and ARAR-Appropriate Cover of 11 Residue Piles and Soil Area Greater than PRGs

Same as Alternative 2.

2.4.4 Offsite Disposal of Residue Piles NP-14, RR1-3, and MP1-21

The three residue piles would be excavated, treated as necessary to meet land disposal restriction of 0.75 mg/L lead in the toxicity characteristic leaching procedure (TCLP) extract, and disposed of offsite in a RCRA Subtitle C or Subtitle D landfill. Immobilization agents to reduce leaching and meet the land disposal requirements (LDRs) would be chosen based on the results of bench-scale testing or by the land disposal facility. Once treated to meet LDRs, the residue will no longer be a characteristic hazardous waste because the TCLP result should be reduced to less than 5 mg/L for lead. As a result the treated residue could be disposed of as a solid waste in a Subtitle D landfill.

It is assumed for costing that the immobilization would be performed offsite at a Subtitle C landfill. A Subtitle C landfill with solidification capabilities and located in Peoria, Illinois, within 120 miles of the Eagle Zinc site was assumed for estimating treatment and disposal costs. Treatment could be performed onsite, although it would likely be more expensive than offsite treatment. This cost though is counterbalanced by lower hauling and disposal costs at a local Subtitle D landfill.

2.4.5 Regrade and ARAR-Appropriate Cover over Southwest Area

Same as Alternative 3.

2.5 Alternative 5—Offsite Disposal of Residue Piles, Regrade, and ARAR-Appropriate Cover Over Residue and In Situ Groundwater Treatment

The main components of Alternative 5 are shown in Figure 4 and are as follows.

2.5.1 Institutional Controls

Same as Alternative 2.

2.5.2 Monitoring and Assessment

Same as Alternative 2.

2.5.3 Offsite Disposal of Residue Piles

The 15 residue piles and the area of soil around sample location A1-3-S1 exceeding direct contact industrial PRGs or PRGs protective of groundwater would be excavated, treated as necessary to meet land disposal restriction of 0.75 mg/L in the TCLP extract, and disposed offsite in a landfill.

The cost estimate assumes that 2,100 yd^3 of residue from piles NP-14, RR1-3 and MP1-21 would be treated at a Subtitle C landfill to meet LDRs as in Alternative 4. The remaining

41,400 yd^3 of residue from the piles exceeding PRGs would be disposed at the Subtitle D landfill. It was assumed for costing that a local Subtitle D landfill located in Litchfield, Illinois, within 10 miles of the facility would be used for disposal.

2.5.4 Regrade and ARAR-Appropriate Cover over Residue

This component is similar to that in Alternative 3, though it would be expanded to include exposed residue onsite, an area of 34 acres. This area overlies the area of groundwater exceeding groundwater and surface water PRGs. The cover would reduce leaching of contamination in soil which could result in exceedances of groundwater and surface water PRGs. It would also contribute to reduction in the contaminated sediment resulting from the erosion of residue.

2.5.5 In Situ Treatment of Groundwater

A permeable reactive barrier wall would be installed parallel to the Western Drainage areas in order to protect surface water. It would treat groundwater prior to discharge to surface water to reduce the concentrations of inorganics exceeding surface water PRGs, in particular cadmium, iron, and zinc that exceed Illinois Water Quality Standards (IWQS). The reactive barrier material would be determined based on design studies but may include limestone to increase groundwater pH and promote metal precipitation or other materials to promote metal adsorption. The reactive material may also consist of an organic media, such as manure, and sand to create anaerobic conditions, to reduce existing sulfate to sulfide. The sulfide then reduces the inorganics to inorganic sulfides, which have low solubility in water. They precipitate on the aquifer matrix, thus lowering the dissolved concentrations. For costing purposes, the limestone reactive barrier material was assumed.

The specific alignment of the wall would be determined during design. The preliminary alignment for cost estimating is along both branches of the western drainageway, a distance of 3,000 feet, as shown in Figure 4. The reactive barrier wall is assumed to be constructed to a depth ranging from about 10 feet below ground at its northernmost alignment to 27 feet below ground at its westernmost location. This depth was chosen to place the reactive material across the water table and to a depth of at least 3 feet into the low permeability silty clay underlying the residue. The lower 10 feet, on average, in the trench would be filled with reactive material. A geotextile would be placed on top of the reactive material and the remaining area above would be backfilled with low permeability clay.

3 Detailed Analysis of Remedial Alternatives

The detailed analysis of alternatives presents the relevant information needed to compare the remedial alternatives for the Eagle Zinc site. Detailed analysis of alternatives consists of the following components:

- A detailed evaluation of each alternative against seven National Contingency Plan (NCP) evaluation criteria (the remaining two criteria will be evaluated in the Record of Decision)
- A comparative evaluation

The detailed evaluation is presented in table format. The comparative evaluation is presented in text and highlights the most important factors that distinguish alternatives from each other.

3.1 Evaluation Criteria

In accordance with the NCP remedial actions must accomplish the following goals:

- Be protective of human health and the environment.
- Attain ARARs or provide grounds for invoking a waiver of ARARs that cannot be achieved.
- Be cost-effective.
- Use permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable.
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element.

The NCP also emphasizes long-term effectiveness and related considerations including:

- The long-term uncertainties associated with land disposal
- The goals, objectives, and requirements of the Solid Waste Disposal Act
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bio-accumulate
- The short-and long-term potential for adverse health effects from human exposure
- Long-term maintenance costs
- The potential for future remedial action costs if the selected remedial action fails
- The potential threat to human health and the environment associated with excavation, transportation, disposal, or containment

Provisions of the NCP require that each alternative be evaluated against nine criteria listed in 40 CFR 300.430(e)(9). These criteria were published in the March 8, 1990 *Federal Register* (55 FR 8666) to provide grounds for comparison of the relative performance of the alternatives and to identify their advantages and disadvantages. This approach is intended to provide sufficient information to adequately compare the alternatives and to select the most appropriate alternative for implementation at the site as a remedial action. The evaluation criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

- Community acceptance
- State acceptance

The criteria are divided into three groups: threshold, balancing, and modifying criteria. Threshold criteria must be met by a particular alternative for it to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria—either they are met by a particular alternative or that alternative is not considered acceptable. The two threshold criteria are overall protection of human health and the environment, and compliance with ARARs. If ARARs cannot be met, a waiver may be obtained in situations where one of the six exceptions listed in the NCP occur (see 40 CFR 300.430 (f)(1)(ii)(C)(1 to 6).

Unlike the threshold criteria, the five balancing criteria weigh the trade-offs between alternatives. A low rating on one balancing criterion can be compensated by a high rating on another. The five balancing criteria are:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

The modifying criteria are community and state acceptance. These are evaluated following public comment and are used to modify the selection of the recommended alternative. The remaining seven evaluation criteria, encompassing both threshold and balancing criteria, are briefly described below.

3.1.1 Threshold Criteria

To be eligible for selection, an alternative must meet the two threshold criteria described below, or in the case of ARARs, must justify for a waiver that is appropriate.

Overall Protection of Human Health and the Environment

Protectiveness is the primary requirement that remedial actions must meet under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). A remedy is protective if it adequately eliminates, reduces, or controls current and potential risks posed by the site through each exposure pathway. The assessment against this criterion describes how the alternative achieves and maintains protection of human health and the environment.

Compliance with ARARs

Compliance with ARARs is one of the statutory requirements of remedy selection. ARARs are cleanup standards, standards of control, and other substantive environmental statutes or regulations which are either "applicable" or "relevant and appropriate" to the CERCLA cleanup action (42 USC 9621 [d] [2]). Applicable requirements address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site. Relevant and appropriate requirements are those that while not applicable, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to environmental or technical factors at a particular site. The

assessment against this criterion describes how the alternative complies with ARARs or presents the rationale for waiving an ARAR.

3.1.2 Balancing Criteria

The five criteria listed below are used to weigh the tradeoffs between alternatives.

Long-Term Effectiveness and Permanence

This criterion reflects CERCLA's emphasis on implementing remedies that will ensure protection of human health and the environment in both the long term and the short term. The assessment of alternatives against this criterion evaluates the residual risks at a site after completing a remedial action or enacting a no-action alternative and includes evaluation of the adequacy and reliability of controls.

Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the statutory preference for remedies that employ treatment as a principal element. Assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ. The criterion is specific to evaluating only how treatment reduces toxicity, mobility, or volume and does not address containment actions such as capping.

Short-Term Effectiveness

This criterion addresses short-term impacts of the alternatives. Assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment (i.e., minimizing risks associated with an alternative) during the construction and implementation of a remedy until the response objectives have been met.

Implementability

Assessment against this criterion evaluates the technical and administrative feasibility of the alternative and the availability of the goods and services needed to implement it.

Cost

Cost encompasses engineering, construction, and operation and maintenance (O&M) costs incurred over the life of the project. Assessment against this criterion is based on the estimated present worth of these costs for each alternative. Present worth is a method of evaluating expenditures such as construction and O&M that occur over different lengths of time. This allows costs for remedial alternatives to be compared by discounting costs to the year that the alternative is implemented. The present worth of a project represents the amount of money that, if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover costs associated with the remedial action. As stated in the RI/FS guidance (USEPA 1988a), these estimated costs are expected to provide an accuracy of plus 50 percent to minus 30 percent. USEPA provided additional guidance on preparing feasibility study cost estimates in 2000 (USEPA 2000). Appendix A provides a breakdown of the cost estimate for each alternative.

The level of detail required to analyze each alternative against these evaluation criteria depends on the nature and complexity of the site, the types of technologies and alternatives

being considered, and other project-specific considerations. The analysis is conducted in sufficient detail to understand the significant aspects of each alternative and to identify the uncertainties associated with the evaluation.

The cost estimates presented herein were developed strictly for comparing the alternatives. The final costs of the project and the resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, the implementation schedule, the firm selected for final engineering design, and other variables. Therefore, final project costs will vary from the cost estimates. Because of these factors, project feasibility and funding needs must be reviewed carefully before specific financial decisions are made or project budgets are established to help ensure proper project evaluation and adequate funding.

The cost estimates are order-of-magnitude estimates having an intended accuracy range of +50 to -30 percent. The range applies only to the alternatives as they are defined in Section 2 and does not account for changes in the scope of the alternatives. Selection of specific technologies or processes to configure remedial alternatives is intended not to limit flexibility during remedial design, but to provide a basis for preparing cost estimates. The specific details of remedial actions and cost estimates would be refined during final design.

3.2 Detailed Evaluation of Alternatives

The alternatives were evaluated in detail using the seven evaluation criteria described in Section 3.1.

The USEPA's Hydrologic Evaluation of Landfill Performance (HELP) model was used to evaluate how the soil cover and cap would reduce infiltration from that currently occurring. The HELP model is a quasi-two-dimensional hydrologic model for conducting water balance analyses of landfills, cover systems, and other solid waste containment facilities. Model input includes weather, soil and design data. The primary purpose of the model is to assist in the comparison of design alternatives. Version 3 of the HELP model was used to simulate hydrologic processes of the remedial alternatives. The model was run for a simulation period of an average rainfall year (40.52 inches in 2001) with precipitation from the Hillsboro, Illinois, station data (station 114108). The precipitation data from 2001 was selected based on review of historical data, which indicated 2001 to be an average rainfall year. Synthetic data for weather parameters such as temperature, evapotranspiration, and solar radiation were generated for the location in the HELP model.

Three scenarios were modeled:

- Scenario 1: Existing conditions used in Alternative 1
- Scenario 2: Soil Cover (0.5 ft silty loam and 0.5 ft clay) used in Alternatives 2, 3, 4 and 5
- Scenario 3: Multilayer Cap (2 ft clay and 40 mil HDPE liner) used in Alternative 3

Table 1 summarizes the major assumptions included in each of the scenarios and the results.

TABLE 1
HELP Model Assumptions and Results
Technical Memorandum 2—Eagle Zinc Site

	Scenario 1: Existing Conditions	Scenario 2: 1-Foot Soil Cover	Scenario 3: Multilayer Cap
Average Slope	0.60%	2%	2%
Vegetation	None	Grass covered	Grass covered
Existing soil layer permeability	10^{-3} cm/sec	—	—
Lowest permeability layer	—	Compacted Clay	HDPE liner
Results-Average Annual Infiltration	9.9 in/yr	6.5 in/yr	< 0.1 in/yr

The model results show that a 34 percent reduction in percolation to the groundwater table may be achieved by covering the residue with a 1-foot-thick layer of soil (Scenario 2) compared to the percolation through the existing residue at the site (Scenario 1). A 2-foot layer results in a 50 percent reduction in percolation compared to existing conditions. Less than 0.1 inch of rainfall would percolate to the groundwater table by placing a multilayer low permeability cap over the residue (Scenario 3), thereby reducing percolation by more than 99 percent. These results and additional detailed evaluations for the alternatives are presented in Table 2.

3.3 Comparative Analysis

3.3.1 Overall Protection of Human Health and the Environment

Alternative 1—No Action is not considered protective of public health and the environment because unacceptable risks to industrial and construction workers are present under future industrial land use. Also unacceptable risks would be posed to recreational users of the site. In addition leaching of metals to groundwater with subsequent discharge to surface water would continue to result in groundwater and surface water PRG exceedances. Adverse impacts to ecological receptors may also occur if aquatic habitats improve in the future or if the residue piles are disturbed.

TABLE 2
Detailed Evaluation of Remedial Alternatives
Technical Memorandum 2—Eagle Zinc Site

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2—Immobilization, Regrade, and ARAR-Appropriate Cover	Alternative 3— Regrade and ARAR-Appropriate Cap and Cover	Alternative 4—Offsite Disposal, Regrade, and ARAR-Appropriate Cover	Alternative 5—Offsite Disposal of Residue Piles, Regrade, and ARAR-Appropriate Cover over Residue and In Situ Groundwater Treatment
1. Overall protection of human health and the environment	Arsenic, lead, and zinc in residue piles would pose unacceptable risks under future industrial land use. Lead in some of the residue piles also poses unacceptable risks for construction workers and recreational users of the site. Direct contact with surface soils could cause unacceptable risks from exposure to lead in the area around sample location A1-3-S1. Leaching of lead, cadmium, manganese, and zinc from the residue piles to groundwater with subsequent discharge to surface water would continue to result in PRG exceedance. Potential adverse impacts to ecological receptors may occur if aquatic habitat improves in the future. Potential adverse impacts to aquatic and terrestrial receptors may occur if residue piles are disturbed in the future.	Immobilization would treat cadmium, lead, and possibly zinc, if necessary, in residue piles MP1-21, NP-14, and RR1-3 to eliminate leaching to groundwater at concentrations causing exceedance of groundwater and/or surface water standards. Consolidation and covering of residue piles and the soil area exceeding PRGs would eliminate direct contact risks. Covering of residue piles would also protect environmental receptors by preventing wind or runoff erosion of residue. Covering of residue piles in a 5-acre area in the southwestern area of the site would reduce infiltration and leaching of cadmium and zinc in the underlying residue to groundwater by an estimated 34 percent compared to current conditions in this area. Institutional controls would identify the area of residue and soil contamination and minimize the potential for risks resulting from excavation. Institutional controls would also require future site development to cover residues, further reducing potential risks to the environment from erosion. Monitoring of groundwater, surface water, and habitat quality would allow early identification of impacts on ecological receptors.	Low permeability cap of residue consolidated from piles MP1-21, NP-14, and RR1-3 would prevent direct contact risks, leaching of cadmium, lead, and zinc, and erosion of residue. Infiltration, and leaching are reduced by over 99 percent. Consolidation and covering of residue piles and the soil area exceeding PRGs would eliminate direct contact risks. Covering of residue piles would also protect environmental receptors by preventing wind or runoff erosion of residue. Covering of residue piles and residue in a 20-acre area in the southwestern part of the site would reduce infiltration and leaching of cadmium and zinc in the underlying residue to groundwater by an estimated 34 percent, compared to current conditions in this area. Institutional controls would identify the area of residue and soil contamination and minimize the potential for risks resulting from excavation. Institutional controls will also require future site development to cover residues, further reducing potential risks to the environment from erosion. Monitoring of groundwater, surface water, and habitat quality would allow early identification of impacts on ecological receptors.	Offsite disposal of residue from piles MP1-21, NP-14, and RR1-3 would prevent direct contact risks, leaching of cadmium, lead, and zinc, and erosion of residue. Consolidation and covering of residue piles and the soil area exceeding PRGs would eliminate direct contact risks. Covering of residue piles would also protect environmental receptors by preventing wind or runoff erosion of residue. Covering of residue piles and residue in a 20-acre area in the southwestern part of the site would reduce infiltration and leaching of cadmium and zinc in the underlying residue to groundwater by an estimated 34 percent, compared to current conditions in this area. Institutional controls would identify the area of residue and soil contamination and minimize the potential for risks resulting from excavation. Institutional controls would also require future site development to cover residues, further reducing potential risks to the environment from erosion. Monitoring of groundwater, surface water, and habitat quality would allow early identification of impacts on ecological receptors.	Offsite disposal of residue piles would prevent direct contact risks and leaching of cadmium, lead, and zinc. Offsite disposal of residue piles would also protect environmental receptors by preventing wind or runoff erosion of residue. Covering of residue across the entire site would reduce infiltration and leaching of cadmium and zinc in the underlying residue to groundwater by an estimated 34 percent. Monitoring of groundwater, surface water, and habitat quality would allow early identification of impacts on environmental receptors from erosion of residue. In situ treatment of groundwater before discharge to the drainageway would reduce threat to ecological receptors and potentially allow surface water standards to be met.
2. Compliance with ARARs[a]	Leaching of lead, cadmium manganese, and zinc from the residue piles to groundwater would continue to result in exceedance of IWQS Class I groundwater standards. Groundwater would continue to exceed IWQS Class I groundwater standards for lead, cadmium, manganese, and zinc. Surface water in the drainageways would continue to exceed IWQS for cadmium, iron, and zinc. Soil TBCs within TACO and EPA PRGs would not be met.	Immobilization would help attain compliance with groundwater and surface water ARARs. Covering of residue piles in a 5-acre area in the southwestern part of the site would help attain compliance with groundwater and surface water ARARs. It is likely that groundwater and surface water standards would continue to be exceeded for the foreseeable future, even with immobilization and the 5-acre soil cover.	Low permeability cap would help attain compliance with groundwater and surface water ARARs. Covering of residue in a 20-acre area in the southwestern part of the site would help attain compliance with groundwater and surface water ARARs. Groundwater and surface water standards may be met more quickly as a result of reduced infiltration through the residue in the southwestern area of the site.	Would comply with RCRA LDRs for D008 characteristic hazardous waste (0.75 mg/L lead in the extract) and would be disposed in accordance with RCRA requirements. Covering of residue in a 20-acre area in the southwestern part of the site would help attain compliance with groundwater and surface water ARARs. Groundwater and surface water standards may be met more quickly as a result of reduced infiltration through the residue in the southwestern area of the site.	Would comply with RCRA LDRs for D008 characteristic hazardous waste (0.75 mg/L lead in the extract) and would be disposed in accordance with RCRA requirements. Covering of residue across the site would help attain compliance with groundwater and surface water ARARs. Groundwater and surface water standards may be met more quickly as a result of reduced infiltration through the residue. Surface water standards would be met more quickly as a result of in situ treatment of groundwater discharging to the southwest drainageways.

TABLE 2
Detailed Evaluation of Remedial Alternatives
Technical Memorandum 2—Eagle Zinc Site

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2—Immobilization, Regrade, and ARAR-Appropriate Cover	Alternative 3— Regrade and ARAR-Appropriate Cap and Cover	Alternative 4—Offsite Disposal, Regrade, and ARAR-Appropriate Cover	Alternative 5—Offsite Disposal of Residue Piles, Regrade, and ARAR-Appropriate Cover over Residue and In Situ Groundwater Treatment
3. Long-term effectiveness and permanence					
a. Magnitude of residual risks	Risks would remain because there would be minimal attenuation of the inorganic COCs.	COCs are left in place so long-term residual risks would remain if exposure occurs. The likelihood of exposure would be greatly reduced, however, because residue and soil are covered and institutional controls would provide notification of the risks associated with excavation or use of groundwater.	COCs are left in place so long-term residual risks would remain if exposure occurs. The likelihood of exposure would be greatly reduced, however, because residue and soil are covered and institutional controls would provide notification of the risks associated with excavation or use of groundwater.	Most of the residue piles containing the site COCs are left in place, so long-term residual risks would remain if exposure occurs. The likelihood of exposure would be greatly reduced, however, because residue and soil are covered and institutional controls would provide notification of the risks associated with excavation or use of groundwater. The potential for leaching from the three residue piles disposed offsite would be eliminated.	Residue piles and soil exceeding PRGs are removed from site so residual risks do not remain. The potential for leaching from the three residue piles disposed offsite would be eliminated.
b. Adequacy and reliability of controls	Not applicable.	Immobilization has been proven as an adequate and reliable control for preventing leaching of metals such as lead, cadmium, and zinc. The 1-foot-thick soil cover would be adequate and reliable to prevent direct contact under industrial land use. It would also be adequate and reliable to prevent erosion. Institutional controls, such as deed restrictions are necessary to prevent intrusive activities into residue and impacted soils. They are considered adequate and reliable.	Low permeability cap would be adequate and reliable in preventing direct contact, infiltration, and erosion of residue with concentrations exceeding PRGs. The 1-foot thick soil cover would be adequate and reliable to prevent direct contact under industrial land use. It would also be adequate and reliable to prevent erosion. Institutional controls, such as deed restrictions are necessary to prevent intrusive activities into residue and impacted soils. They are considered adequate and reliable.	Excavation, offsite treatment, and disposal are adequate and reliable in eliminating future leaching to groundwater. The 1-foot-thick soil cover would be adequate and reliable to prevent direct contact under industrial land use. It would also be adequate and reliable to prevent erosion. Institutional controls, such as deed restrictions are necessary to prevent intrusive activities into residue and impacted soils. They are considered adequate and reliable.	Excavation, offsite treatment, and disposal are adequate and reliable in eliminating direct contact risks and future leaching to groundwater. The 1-foot-thick soil cover across the site would be adequate and reliable to reduce infiltration through the residue.
4. Reduction of toxicity, mobility, or volume through treatment					
a. Treatment process used	Not applicable.	Immobilization reduces the mobility of lead, cadmium and zinc in residue to prevent leaching.	No treatment used	The excavated soils would be treated by solidification before offsite disposal, as necessary, to meet LDR requirements.	The excavated soils would be treated by solidification before offsite disposal, as necessary, to meet LDR requirements.
b. Degree and quantity of reduction of toxicity, mobility, or volume	Not applicable	About 2,100 yd^3 of residue would be treated to prevent leaching at concentrations above groundwater standards.	Not applicable.	About 2,100 yd^3 of residue would be treated to meet the D008 LDR of 0.075 mg/L lead in the waste extract.	About 2,100 yd^3 of residue would be treated to meet the D008 LDR of 0.075 mg/L lead in the waste extract.
c. Irreversibility of reduction of toxicity, mobility, or volume	Not applicable	Immobilization of COCs in residue would be reversible because COCs are not destroyed. This would be unlikely, however, because residue would be covered and not exposed to processes that could increase leachability.	Not applicable.	Immobilization of COCs in residue would be reversible because COCs are not destroyed. This would be unlikely, however, because treated residue would be disposed in a landfill cell with multiple containment systems.	Immobilization of COCs in residue would be reversible because COCs are not destroyed. This would be unlikely, however, because treated residue would be disposed in a landfill cell with multiple containment systems
d. Type and quantity of treatment residuals	None, because no treatment included.	Additional volume of residue of 10 to 30 percent would be generated through immobilization technologies.	Not applicable.	Additional volume of residue of 10 to 30 percent would be generated through immobilization technologies.	Additional volume of residue of 10 to 30 percent would be generated through immobilization technologies.

TABLE 2
Detailed Evaluation of Remedial Alternatives
Technical Memorandum 2—Eagle Zinc Site

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2—Immobilization, Regrade, and ARAR-Appropriate Cover	Alternative 3— Regrade and ARAR-Appropriate Cap and Cover	Alternative 4—Offsite Disposal, Regrade, and ARAR-Appropriate Cover	Alternative 5—Offsite Disposal of Residue Piles, Regrade, and ARAR-Appropriate Cover over Residue and In Situ Groundwater Treatment
e. Statutory preference for treatment as a principal element	Preference would not be met for soil because treatment would not be included.	Preference would be met for residue.	Preference not met for residue and soil because no treatment included.	Preference would be met for residue.	Preference would be met for residue and groundwater.
5. Short-term effectiveness					
a. Protection of workers during remedial action	No remedial construction, so no risks to workers.	Risks from exposure to COCs in dust during construction activities can be controlled through proper health and safety procedures included in the Health and Safety Plan.	Risks from exposure to COCs in dust during construction activities can be controlled through proper health and safety procedures included in the Health and Safety Plan.	Risks from exposure to COCs in dust during construction activities can be controlled through proper health and safety procedures included in the Health and Safety Plan.	Risks from exposure to COCs in dust during construction activities can be controlled through proper health and safety procedures included in the Health and Safety Plan.
b. Protection of community during remedial action	No remedial construction, so no short-term risks to community.	Minimal risks to community because there is some offsite truck traffic. Control of dust emissions would be part of construction plan.	Minimal risks to community because there is some offsite truck traffic. Control of dust emissions would be part of construction plan.	There would be a relatively minor short-term safety-related risk to community because of the number of trucks (about 150) used to transport excavated residue for offsite disposal.	There are short-term safety-related risk to community because of the number of trucks (about 3,200) used to transport excavated residue and soil for offsite disposal.
c. Environmental impacts of remedial action	No remedial construction, so no environmental impacts from remedial action.	Dust emissions during excavation and placement of residue could cause risks to the environment but would be controlled to reduce threat. Silt fencing would be used to eliminate soil erosion runoff during excavation and placement of the piles of residue.	Dust emissions during excavation and placement of residue could cause risks to the environment but would be controlled to reduce threat. Silt fencing would be used to eliminate soil erosion runoff during excavation and placement of the piles of residue.	Dust emissions during excavation and placement of residue could cause risks to the environment but would be controlled to reduce threat. Silt fencing would be used to eliminate soil erosion runoff during excavation and placement of the piles of residue.	Dust emissions during excavation and placement of residue could cause risks to the environment but would be controlled to reduce threat. Silt fencing would be used to eliminate soil erosion runoff during excavation and placement of the piles of residue.
d. Time until RAOs are achieved	The RAOs would not be met in the foreseeable future.	The total estimated time of construction is 3 months (immobilization 1 month; regrade and cover 2 months).	The total estimated time of construction is 5 months (cap 2 months; regrade and cover 3 months).	The total estimated time of construction is 4 months (offsite disposal 1 month: regrade and cover 3 months).	The total estimated time of construction is 6 months (offsite disposal 2 month: regrade and cover 4 months).
6.Implementability					
a. Technical feasibility	No impediments.	The main technical challenge would be to ensure proper mixing and delivery of immobilization agent. Bench-scale treatability testing would be done to determine reagents and mix ratios.	No impediments.	The main technical challenge would be to ensure proper mixing and delivery of immobilization agent.	The main technical challenge would be to ensure proper mixing and delivery of immobilization agent. Also, the pilot test may discover that there are no reactive medias to remove the inorganics from groundwater.
b. Administrative feasibility	No impediments.	No impediments.	No impediments.	No impediments.	There are a limited number of continuous trenching machines. Also the reactive media may not be widely available.
c. Availability of services and materials	None needed.	Services and materials are available.	Services and materials are available.	Services and materials are available.	Services and materials are available.
7. Total Cost					
Direct Capital Cost	$0	$1,500,000	$3,700,000	$4,300,000	$9,900,000
Annual O&M Cost	$0	$36,000	$63,000	$60,000	$83,000
Total Present Worth	$0	$2,030,000	$4,610,000	$5,160,000	$11,800,000

Alternatives 2 through 5 are considered protective because each addresses the human health and environmental risks associated with the site. The alternatives differ in how they address each of the three main risk concerns: the three residue piles posing leaching related risks, the residue piles posing direct contact risks, and the exceedance of PRGs in groundwater and surface water.

Alternative 2 addresses the leaching piles through onsite immobilization and placement below a soil cover. This would eliminate leaching of cadmium, lead, and zinc at levels of concern while also providing a soil cover to reduce infiltration. Reducing infiltration has the added benefit of reducing leaching through the residues located below the treated residue in the southwest portion of the site that currently exceeds groundwater and surface water PRGs. Alternative 3 addresses the leaching piles through placement below a multilayer low permeability cap. This would basically eliminate the leaching of cadmium, lead, and zinc but would require long-term maintenance, as opposed to immobilization that does not rely on long-term maintenance to the same degree. Alternatives 4 and 5 address the leaching piles through excavation, treatment to meet LDRs and disposal offsite at either a Subtitle C or D landfill. These alternatives are considered to have similar protectiveness as Alternative 2 since they will use similar immobilization agents to prevent leaching at levels of concern.

Alternatives 2, 3 and 4 address the residue piles and soil posing direct contact risks through consolidation and covering with a 1-foot soil cover. This is considered protective because it prevents direct contact as well as erosion. The thickness is considered adequate because the future land use is industrial with requirements to manage the soil and residue in accordance with state and federal regulations if future excavation into this area is needed. The 1-foot cover has the added benefit of reduced infiltration over an estimated 5-acre area, thus reducing leaching from underlying residue in the southwestern part of the site that currently exceeds groundwater and surface water PRGs. Alternative 5 addresses this residue and soil through excavation and offsite disposal. This is considered slightly more protective than Alternatives 2, 3, and 4 over the long term because it does not rely on institutional controls as much in the future. However, this is counterbalanced by the transference of the residue and soil to another landfill that requires long-term control.

Alternatives 2 to 5 address the exceedance of PRGs in groundwater and surface water through institutional controls that include monitoring of groundwater, surface water and habitat quality. They also include soil covers that reduce infiltration through the residue, thus reducing the concentrations of COCs in groundwater and surface water. Alternative 5 has a 34-acre cover and is expected to result in the greatest decline in groundwater and surface water COC concentrations. The reduction in infiltration is estimated to be 34 percent, however, so continued exceedances of PRGs in groundwater can be expected for long periods of time. It includes a permeable reactive barrier to reduce surface water PRG exceedances resulting from groundwater discharge. Alternatives 3 and 4 include a 20-acre cover in the southwestern part of the site, where most of the groundwater and surface water PRG exceedances occur. Again however, the cover will improve but not eliminate PRG exceedances. Alternative 2 has a 5-acre cover that will have the least effect on reducing PRG exceedances.

3.3.2 Compliance with ARARs

Alternatives other than Alternative 1 comply with ARARs. They differ largely in the time to achieve groundwater or surface water ARARs. This time may be on the order of decades,

though Alternative 5 would eventually achieve groundwater and surface water standards more quickly.

3.3.3 Long-Term Effectiveness and Permanence

Alternatives other than Alternative 1 have similar levels of long-term effectiveness and permanence. Although Alternative 5 offers somewhat greater long-term effectiveness than Alternatives 2, 3, and 4 because the residue piles and soil would be disposed of offsite in a more controlled landfill, this is not considered significant. This is because the site would remain under industrial land use so potential for exposure to residue and soils consolidated onsite below a cover is minimal. The low permeability cap of Alternative 3 is considered less reliable over the long term compared to the immobilization of the leachable residue piles included in Alternatives 2, 4, and 5.

3.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 2, 4, and 5 include treatment to reduce the leaching of lead, cadmium and zinc in an estimated 2,100 yd^3 of residue. Each alternative would use similar immobilization agents to reduce leaching to levels that either meet drinking water MCLs using the SPLP test (Alternative 2), or meet the LDRs using the TCLP test (Alternatives 4 and 5). These alternatives are considered similar relative to this criterion. Alternative 3 does not include treatment, so it is comparatively poor relative to the other alternatives for this criterion.

3.3.5 Short-Term Effectiveness

The five alternatives have minimal impacts with respect to the protection of workers, the community, or the environment during remedial construction, assuming adequate monitoring is conducted and mitigative actions are taken. Most important will be adherence to proper health and safety protection for workers, control of dust emissions during excavation and loading of trucks and control of erosion during excavation through silt fencing. Alternative 5 has the greatest potential to have adverse human health and environmental impacts during construction because much of the site (34 acres) would undergo excavation.

3.3.6 Implementability

There are no significant differences between alternatives 2, 3 and 4 relative to implementability concerns. The main technical challenge for the remedial alternatives is in determining the proper immobilization agents to be used in Alternatives 2, 4, and 5. Bench-scale treatability testing would be performed to establish the agents and proportions to be used. The permeable reactive barrier wall of Alternative 5 may not be technically implementable if a suitable reactive media is not found during predesign testing.

3.3.7 Cost

An overview of the cost analysis performed for this TM and the detailed breakdowns for each of the alternatives are presented in Appendix A, with the costs listed in Table 3.

The lowest cost alternative, excluding Alternative 1, is Alternative 2 with a present worth of $2,000,000. It is less costly than the remaining alternatives largely because it includes a 5-acre cover compared to the 20-acre covers in Alternatives 3 and 4 and a 34-acre cover in

Alternative 5. Alternatives 3 and 4 are $4,600,000 and $5,200,000 in present value, respectively. Alternative 5 is considerably more expensive with an estimated present value of $11,000,000. This is largely because of the greater costs in offsite disposal of the residue piles as well as the high cost of the in situ groundwater permeable reactive barrier wall.

4 References

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CH2M HILL. 2006. *Technical Memorandum 1: Feasibility Study Supplement for the Eagle Zinc Company Site, Hillsboro, Illinois*. June.

ENVIRON. 2004a. *Remedial Investigation Report, Eagle Zinc Company Site, Hillsboro, Illinois*. November.

ENVIRON. 2004b. *Human Health Risk Assessment, Remedial Investigation/Feasibility Study, Eagle Zinc Company Site, Hillsboro, Illinois*. March.

ENVIRON. 2004c. *Human Health Risk Assessment (revised), Remedial Investigation/Feasibility Study, Eagle Zinc Company Site, Hillsboro, Illinois*. August.

ENVIRON. 2006a. *Addendum to the Remedial Investigation Report. Remedial Investigation/Feasibility Study, Eagle Zinc Company Site, Hillsboro, Illinois*. February.

ENVIRON. 2006b. *Feasibility Study Report. Eagle Zinc Company Site, Hillsboro, Illinois*. March.

USEPA. 1988. *Remedial Investigation/Feasibility Study Guidance Document*, EPA.

USEPA. *A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study*. EPA 540-R-00-002. 2000.

Figures

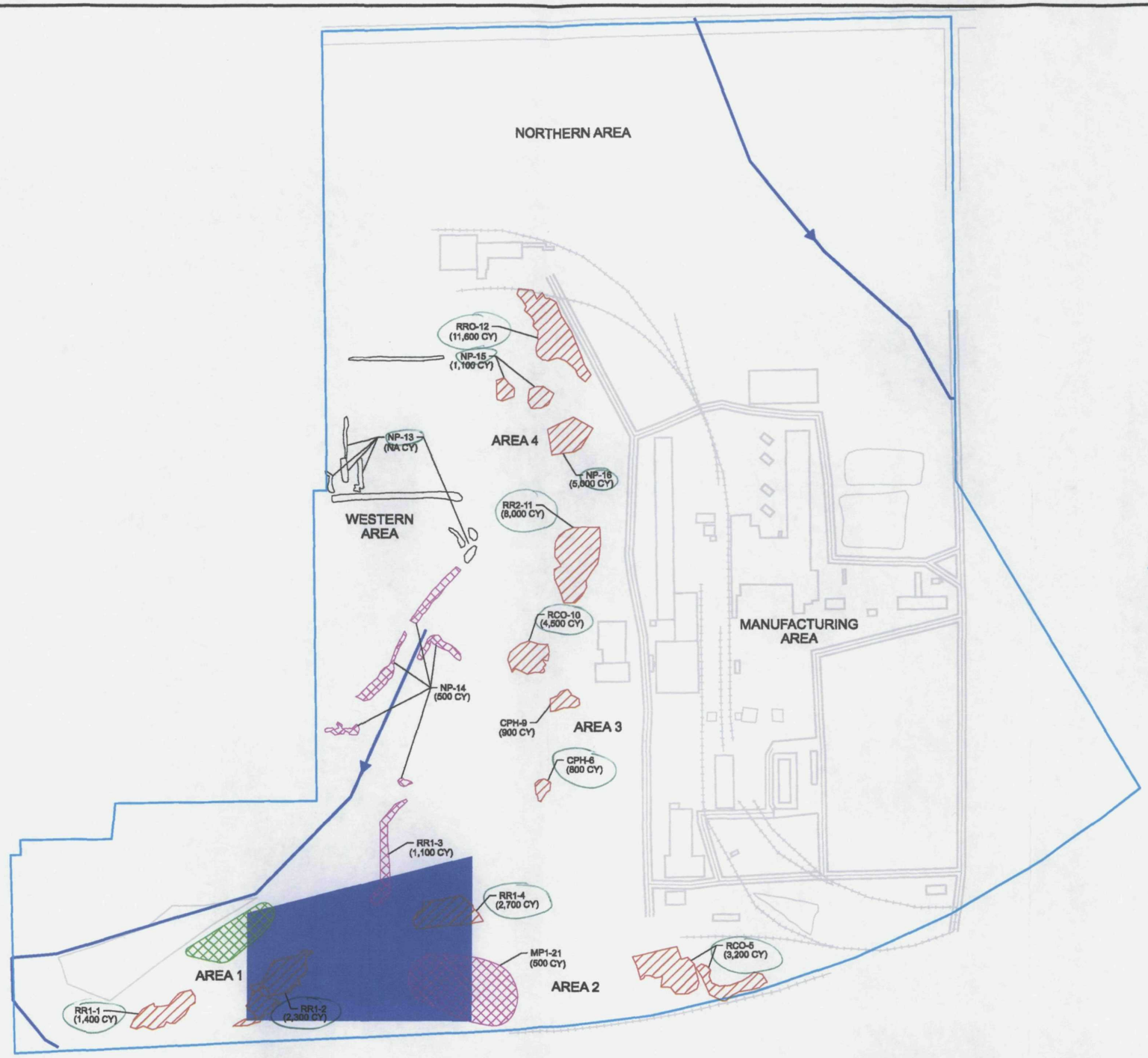

FIGURE 1 - ALTERNATIVE 2
IMMOBILIZATION, REGRADE, AND
ARAR-APPROPRIATE COVER
EAGLE ZINC TM-2

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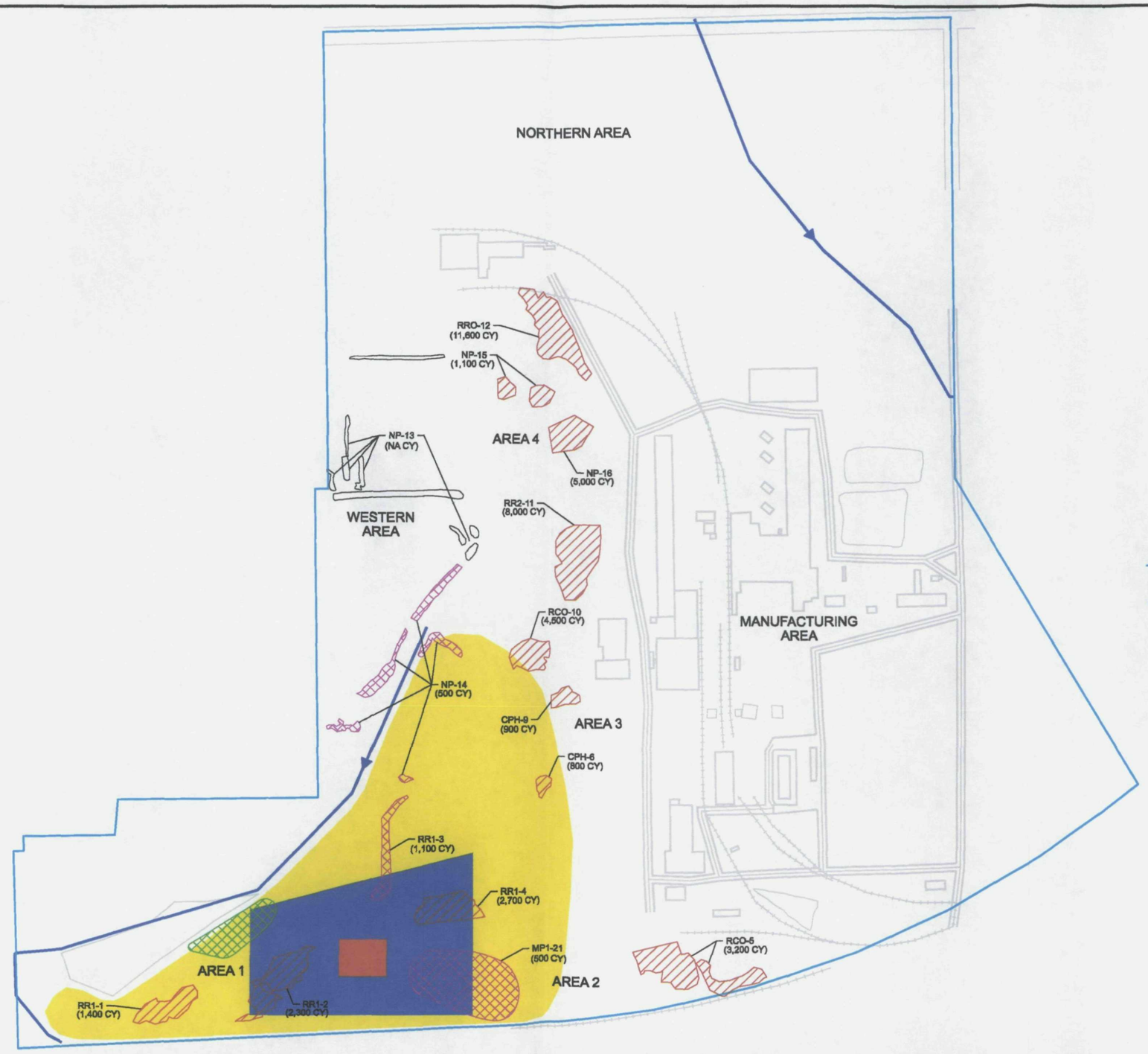

FIGURE 2 - ALTERNATIVE 3
REGRADE, ARAR-APPROPRIATE
CAP AND COVER
EAGLE ZINC TM-2

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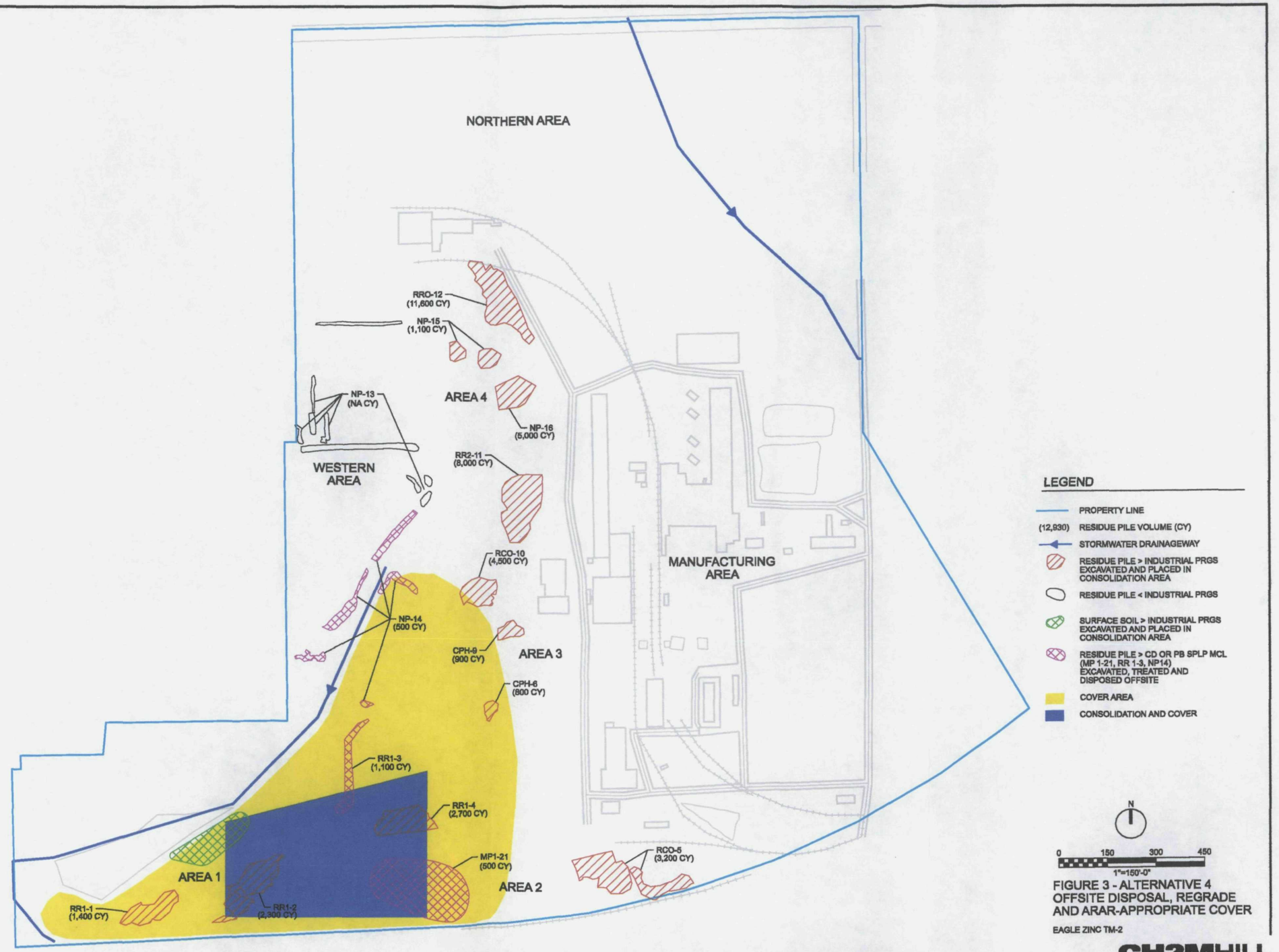

FIGURE 3 - ALTERNATIVE 4
OFFSITE DISPOSAL, REGRADE
AND ARAR-APPROPRIATE COVER

EAGLE ZINC TM-2

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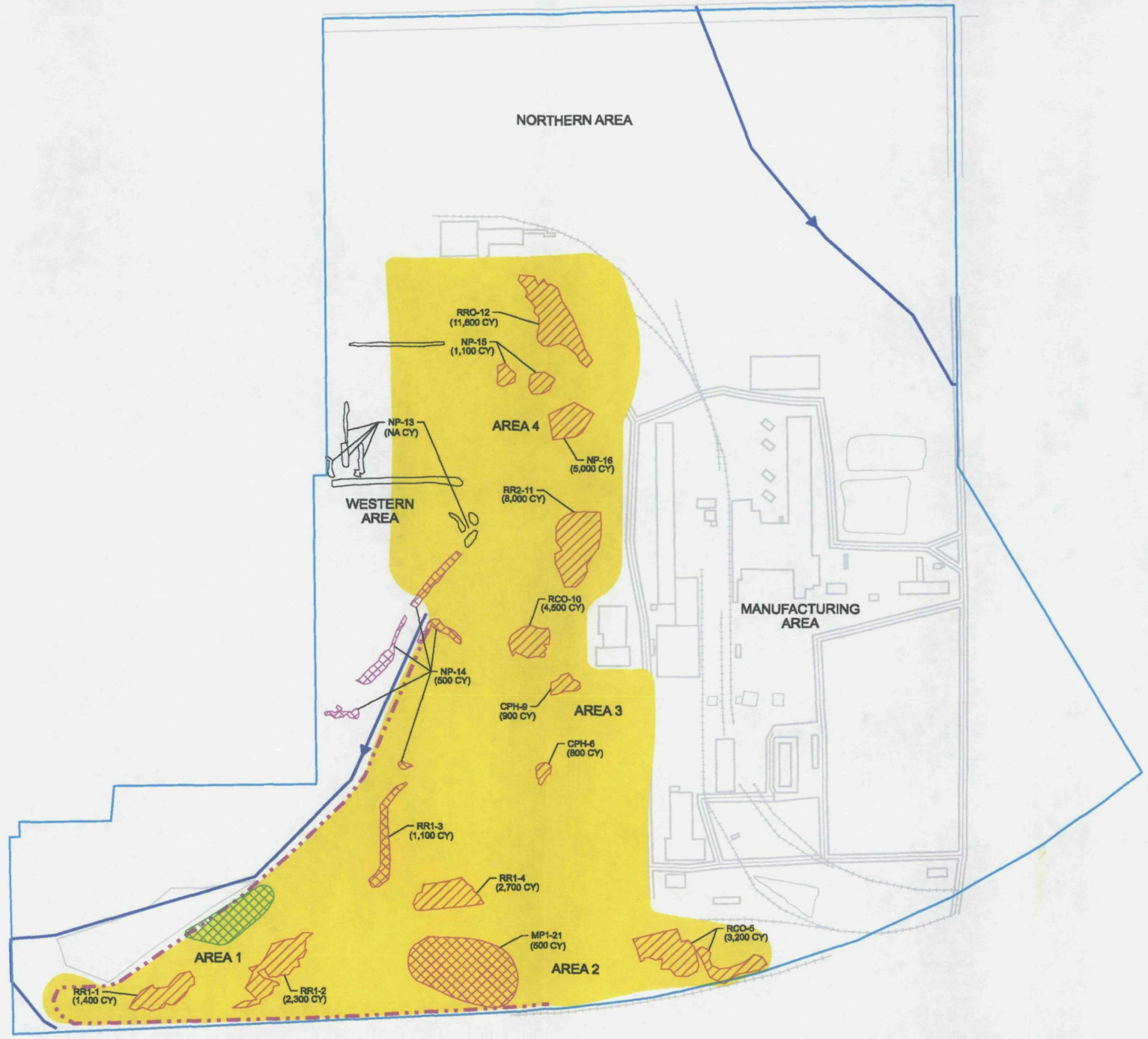

LEGEND

- PROPERTY LINE
- (12,830) RESIDUE PILE VOLUME (CY)
- STORMWATER DRAINAGEWAY
- RESIDUE PILE > INDUSTRIAL PRGS EXCAVATED AND DISPOSED OFFSITE
- RESIDUE PILE < INDUSTRIAL PRGS
- SURFACE SOIL > INDUSTRIAL PRGS EXCAVATED AND DISPOSED OFFSITE
- RESIDUE PILE > CD OR PB SPLP MCL (MP 1-21, RR 1-3, NP14) EXCAVATED, TREATED AND DISPOSED OFFSITE
- COVER AREA
- PERMEABLE REACTICE BARRIER WALL

N

0 150 300 450

1"=150'-0"

FIGURE 4 - ALTERNATIVE 5
OFFSITE DISPOSAL OF ALL RESIDUE PILES, REGRADE AND ARAR-APPROPRIATE COVER OVER ALL RESIDUE AND IN SITU GROUNDWATER TREATMENT

EAGLE ZINC TM-2

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Appendix A
Cost Estimates

Alternative: **Alternative 1**
Name: **No Action**

COST ESTIMATE SUMMARY

Site: Eagle Zinc
Location: Hillsboro, Illinois
Phase Feasibility Study
Base Year 2005
Date: 8/2/2006 15:33

Description: No additional actions undertaken.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Alternative					
No construction				$0	
TOTAL CAPITAL COST				$0	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
None	0	LS	$5,000	$0	
TOTAL ANNUAL O&M COST				$0	

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$0	$0	
5 year Review	10	1	LS	$0	$0	
5 year Review	15	1	LS	$0	$0	
5 year Review	20	1	LS	$0	$0	
5 year Review	25	1	LS	$0	$0	
5 year Review	30	1	LS	$0	$0	
5 year Review	35	1	LS	$0	$0	
5 year Review	40	1	LS	$0	$0	
5 year Review	45	1	LS	$0	$0	
5 year Review	50	1	LS	$0	$0	
			Total		$0	

PRESENT VALUE ANALYSIS

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
CAPITAL COST	0	$0	$0	1.000	$0	
ANNUAL O&M COST	1 to 50	$0	$0	13.80	$0	
PERIODIC COST	5	$0	$0	0.71	$0	
PERIODIC COST	10	$0	$0	0.51	$0	
PERIODIC COST	15	$0	$0	0.36	$0	
PERIODIC COST	20	$0	$0	0.26	$0	
PERIODIC COST	25	$0	$0	0.18	$0	
PERIODIC COST	30	$0	$0	0.13	$0	
PERIODIC COST	35	$0	$0	0.09	$0	
PERIODIC COST	40	$0	$0	0.07	$0	
PERIODIC COST	45	$0	$0	0.05	$0	
PERIODIC COST	50	$0	$0	0.03	$0	
		$0			$0	
TOTAL PRESENT VALUE OF ALTERNATIVE					$0	

SOURCE INFORMATION

1. *United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).*

Alternative: **Alternative 2** — **COST ESTIMATE SUMMARY**

Name: **Immobilization, Regrade and ARAR-Appropriatre Cover**

Site: Eagle Zinc
Location: Hillsboro, Illinois
Phase: TM 2 Feasibility Study
Base Year 2006
Date: 8/2/2006 15:33

Description: Ex Situ immobilization of COCs in residue piles NP-14, RR1-3 and MP1-21. Regrade 5 acre area for onsite consolidation. Excavate residue piles and soil and place in consolidation area. Construct 1 foot thick soil cover over consolidation area. Institutional controls include deed notices describing the residue and soil contamination and restrictions on site use and soil excavation.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Site Development Plan	1	LS	$15,000	$15,000	
Predesign Investigations					
Survey site	1	LS	$30,000	$30,000	
Leaching Investigation	1	LS	$20,000	$20,000	
SUBTOTAL				$50,000	
Site Preparation					
Silt Fencing	2,000	FT	$3.23	$6,469	MEANS 18 05 0206
Clear and Grub all Excavation and Consolidation Area	7.0	AC	$7,769	$54,382	MEANS 17 01 0106
Residue Excavation (to Prepare Consolidation Area)	3,700	CY	$5.33	$19,734	MEANS 17-03-0276
Spread and Compact	3,700	CY	$1.01	$3,721	MEANS 17-03-0517
SUBTOTAL				$84,307	
Mobilization/Demobilization	5%			$4,215	
Subcontractor General Conditions	25%			$21,077	
SUBTOTAL				$109,599	
Immobilization					
Soil Excavation and Truck Loading	2,100	CY	$5.33	$11,201	MEANS 17-03-0276
Roller, grader. residue stabilization	2,310	CY	$3.39	$7,830	MEANS 17-03-0602
Sulfide reagent	187,110	LB	$0.075	$14,033	Williams Inc quote
Freight for sulfide reagent	4,678	MI	$2.48	$11,624	MEANS 33-19-0210
Metal TCLP Analysis	23	EA	$251	$5,803	MEANS 33-02-1701
SUBTOTAL				$50,490	
Mobilization/Demobilization	5%			$2,525	
Subcontractor General Conditions	15%			$7,574	
SUBTOTAL				$60,589	
Excavate Piles and Soil and Consolidate					Residue Piles
Residue and Soil Excavation and Truck Loading	41,960	CY	$5.33	$223,799	MEANS 17-03-0276
Residue and Soil Haul to Consolidation Area	771	MI	$2.48	$1,916	MEANS 33-19-0210
SUBTOTAL				$225,715	
Mobilization/Demobilization	5%			$11,286	
Subcontractor General Conditions	15%			$33,857	
SUBTOTAL				$270,858	
5 Acre Cover Construction					5 Acre Cover
Rough Grading of Consolidation Area	24,200	SY	$4.96	$119,973	MEANS 17 03 0101
Fine Grading	24,200	SY	$0.46	$11,037	MEANS 17 03 0103
Low Permeability Clay Layer (6-inches thick)	4,033	CY	$22.15	$89,328	MEANS 17 03 0428
Vegetation Layer (6-inches thick	4,033	CY	$37.20	$150,044	MEANS 18-05-0301
Seeding Vegetation Cover	5	AC	$4,846	$24,229	MEANS 18-05-0402
SUBTOTAL				$394,610	
Mobilization/Demobilization	5%			$19,730	
Subcontractor General Conditions	15%			$59,191	
SUBTOTAL				$473,532	
Soil/Residue Verification Sampling	1	LS	$50,000	$50,000	
SUBTOTAL				$1,030,000	
Contingency	25%			$257,500	10% Scope + 15% Bid
SUBTOTAL				$1,287,500	
Project Management	5%			$64,375	USEPA 2000, p. 5-13, $2M-$10M
Remedial Design	8%			$103,000	USEPA 2000, p. 5-13, $2M-$10M
Construction Management	6%			$77,250	USEPA 2000, p. 5-13, $2M-$10M
SUBTOTAL				$244,625	
TOTAL CAPITAL COST				**$1,500,000**	

Alternative: **Alternative 2** — **COST ESTIMATE SUMMARY**

Name: **Immobilization, Regrade and ARAR-Appropriatre Cover**

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Cover Inspection and Repair					
Cover Annual Inspection	4	Hr	$100	$400	
Cover Repair	1	LS	$4,735	$4,735	Assumes 1% of area repaired
Habitat Survey					
Labor	16	HR	$100	$1,600	
Travel	1	LS	$200	$200	
Groundwater, Surface Water, and Sediment Sampling					
Groundwater and Surface Water Sample	8	LS	$186	$1,485	MEANS 33-02-1701; 4 GW + 4 SW
QC Samples	2	LS	$93	$186	MEANS 33-02-1701
Sediment Sample Metal Analysis	4	LS	$148	$591	MEANS 33-02-1710; 10 metals/sample
QC Samples	1	LS	$148	$148	
Groundwater, Surface Water and					
Labor	48	HRS	$100	$4,800	2 person crew
Equipment - meters	1	LS	$1,200	$1,200	
Consumables	1	LS	$200	$200	
Travel	1	LS	$400	$400	
Data Validation	7.5	HRS	$100	$750	
Reporting	40	HRS	$100	$4,000	
SUBTOTAL				$20,694	
Allowance for Misc. Items	20%			$4,139	
SUBTOTAL				$24,833	
Contingency	25%			$6,208	10% Scope + 15% Bid
SUBTOTAL				$31,041	
Project Management	5%			$1,552	
Technical Support	10%			$3,104	
TOTAL ANNUAL O&M COST				***$36,000***	

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$15,000	$15,000	
5 year Review	10	1	LS	$15,000	$15,000	
5 year Review	15	1	LS	$15,000	$15,000	
5 year Review	20	1	LS	$15,000	$15,000	
5 year Review	25	1	LS	$15,000	$15,000	
5 year Review	30	1	LS	$15,000	$15,000	
5 year Review	35	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	45	1	LS	$15,000	$15,000	
5 year Review	50	1	LS	$15,000	$15,000	
				Total	$170,000	
TOTAL ANNUAL PERIODIC COST					**$170,000**	

PRESENT VALUE ANALYSIS

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
CAPITAL COST	0	$1,500,000	$1,500,000	1.000	$1,500,000	
ANNUAL O&M COST	1 to 50	$1,800,000	$36,000	13.8	$496,827	
PERIODIC COST	5	$15,000	$15,000	0.71	$10,695	
PERIODIC COST	10	$15,000	$15,000	0.51	$7,625	
PERIODIC COST	15	$15,000	$15,000	0.36	$5,437	
PERIODIC COST	20	$15,000	$15,000	0.26	$3,876	
PERIODIC COST	25	$15,000	$15,000	0.18	$2,764	
PERIODIC COST	30	$15,000	$15,000	0.13	$1,971	
PERIODIC COST	35	$15,000	$15,000	0.09	$1,405	
PERIODIC COST	40	$15,000	$15,000	0.07	$1,002	
PERIODIC COST	45	$15,000	$15,000	0.05	$714	
PERIODIC COST	50	$15,000	$15,000	0.03	$509	
		$3,500,000			$2,032,824	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$2,030,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Alternative: **Alternative 3**
Name: **Regrade, ARAR Appropriate Cap and Cover**

COST ESTIMATE SUMMARY

Site: Eagle Zinc
Location: Hillsboro, Illinois
Phase: TM 2 Feasibility Study
Base Year: 2006
Date: 8/2/2006 15:33

Description: Onsite Consolidation and RCRA Multilayer Cap for COCs in residue piles NP-14, RR1-3 and MP1-21. Regrade 20 acre area for onsite consolidation and cover construction. Excavate residue piles and soil and place in consolidation area. Construct 1 foot thick soil cover over consolidation area and an additional 15 acre area in southwest portion of site. Institutional controls include deed notices describing the residue and soil contamination and restrictions on site use and soil excavation.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Site Development Plan	1	LS	$15,000	$15,000	
Predesign Investigations					
Survey site	1	LS	$10,000	$10,000	
Leaching Investigation	1	LS	$30,000	$30,000	
SUBTOTAL				$40,000	
Site Preparation					
Silt Fencing	4,400	FT	$3.23	$14,231	MEANS 18 05 0206
Clear and Grub all Excavation and Consolidation Area	7.0	AC	$7,769	$54,382	MEANS 17 01 0106; 20% of area requires cleanng
Residue Excavation (to Prepare Consolidation Area)	3,700	CY	$5.33	$19,734	MEANS 17-03-0276
Spread and Compact	3,700	CY	$1.01	$3,721	MEANS 17-03-0517
SUBTOTAL				$92,069	
Mobilization/Demobilization	5%			$4,603	
Subcontractor General Conditions	25%			$23,017	
SUBTOTAL				$119,690	
Multilayer Low Permeability Cap					
Soil Excavation and Truck Loading	2,100	CY	$5.33	$11,201	MEANS 17-03-0276
Clay Layerr (10⁻⁷ cm/s)- 2 feet	840	CY	$30.35	$25,490	MEANS 33-08-0507
HDPE Geomembrane (40-mils thick)	11,340	SF	$2.07	$23,477	MEANS 33-08-0571
Sand Drainage Layer- 1 foot thick	420	CY	$14.69	$6,169	MEANS 17-03-0426
Geotextile	1,260	SY	$1.70	$2,138	MEANS 33-08-0531
Freeze-Thaw Layer- 1.5 feet	630	CY	$11.96	$7,537	MEANS 17-03-0423
Vegetation Layer- 0.5 feet thicl	210	CY	$37.20	$7,812	MEANS 18-05-0301
SUBTOTAL				$83,823	
Mobilization/Demobilization	5%			$4,191	
Subcontractor General Conditions	15%			$12,573	
SUBTOTAL				$100,588	
Excavate Piles and Soil and Consolidate					
Residue and Soil Excavation and Truck Loading	41,960	CY	$5.33	$223,799	MEANS 17-03-0276
Residue and Soil Haul to Consolidation Area	771	MI	$2.48	$1,916	MEANS 33-19-0210
SUBTOTAL				$225,715	
Mobilization/Demobilization	5%			$11,286	
Subcontractor General Conditions	15%			$33,857	
SUBTOTAL				$270,858	
Cover Construction (20 Acre Area)					Area is 20 Acres
Rough Grading	96,800	SY	$4.96	$479,890	MEANS 17 03 0101
Fine Grading	96,800	SY	$0.46	$44,147	MEANS 17 03 0103
Low Permeability Clay Layer (6-inches thick)	16,133	CY	$22.15	$357,310	MEANS 17 03 0428
Vegetation Layer (6-inches thick	16,133	CY	$37.20	$600,177	MEANS 18-05-0301
Seeding Vegetation Cover	20	AC	$4,846	$96,915	MEANS 18-05-0402
SUBTOTAL				$1,578,440	
Mobilization/Demobilization	5%			$78,922	
Subcontractor General Conditions	15%			$236,766	
SUBTOTAL				$1,894,128	
Soil/Residue Verification Sampling	1	LS	$50,000	$50,000	
SUBTOTAL				$2,490,000	
Contingency	25%			$622,500	10% Scope + 15% Bid
SUBTOTAL				$3,112,500	
Project Management	5%			$155,625	USEPA 2000, p. 5-13, $2M-$10M
Remedial Design	8%			$249,000	USEPA 2000, p. 5-13, $2M-$10M
Construction Management	6%			$186,750	USEPA 2000, p. 5-13, $2M-$10M
SUBTOTAL				$591,375	
TOTAL CAPITAL COST				**$3,700,000**	

Alternative: **Alternative 3** — **COST ESTIMATE SUMMARY**

Name: **Regrade, ARAR Appropriate Cap and Cover**

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Cover Inspection and Repair					
Cover and Cap Annual Inspection	8	Hr	$100	$800	
Cap and Cover Repair	1	LS	$19,947	$19,947	Assumes 1% of area repaired
Habitat Survey					
Labor	16	HR	$100	$1,600	
Travel	1	LS	$200	$200	
Groundwater, Surface Water, and Sediment Sampling					
Groundwater and Surface Water Sample	8	LS	$186	$1,485	MEANS 33-02-1701; 4 GW + 4 SW
QC Samples	2	LS	$93	$186	MEANS 33-02-1701
Sediment Sample Metal Analysis	4	LS	$148	$591	MEANS 33-02-1710; 10 metals/sample
QC Samples	1	LS	$148	$148	
Groundwater, Surface Water and					
Labor	48	HRS	$100	$4,800	2 person crew
Equipment - meters	1	LS	$500	$1,200	
Consumables	1	LS	$200	$200	
Travel	1	LS	$400	$400	
Data Validation	7.5	HRS	$100	$750	
Reporting	40	HRS	$100	$4,000	
SUBTOTAL				$36,306	
Allowance for Misc. Items	20%			$7,261	
SUBTOTAL				$43,567	
Contingency	25%			$10,892	10% Scope + 15% Bid
SUBTOTAL				$54,459	
Project Management	5%			$2,723	
Technical Support	10%			$5,446	
TOTAL ANNUAL O&M COST				**$63,000**	

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$15,000	$15,000	
5 year Review	10	1	LS	$15,000	$15,000	
5 year Review	15	1	LS	$15,000	$15,000	
5 year Review	20	1	LS	$15,000	$15,000	
5 year Review	25	1	LS	$15,000	$15,000	
5 year Review	30	1	LS	$15,000	$15,000	
5 year Review	35	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	45	1	LS	$15,000	$15,000	
5 year Review	50	1	LS	$15,000	$15,000	
				Total	$170,000	
TOTAL ANNUAL PERIODIC COST					**$170,000**	

PRESENT VALUE ANALYSIS

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
CAPITAL COST	0	$3,700,000	$3,700,000	1.000	$3,700,000	
ANNUAL O&M COST	1 to 50	$3,150,000	$63,000	13.8	$869,447	
PERIODIC COST	5	$15,000	$15,000	0.71	$10,695	
PERIODIC COST	10	$15,000	$15,000	0.51	$7,625	
PERIODIC COST	15	$15,000	$15,000	0.36	$5,437	
PERIODIC COST	20	$15,000	$15,000	0.26	$3,876	
PERIODIC COST	25	$15,000	$15,000	0.18	$2,764	
PERIODIC COST	30	$15,000	$15,000	0.13	$1,971	
PERIODIC COST	35	$15,000	$15,000	0.09	$1,405	
PERIODIC COST	40	$15,000	$15,000	0.07	$1,002	
PERIODIC COST	45	$15,000	$15,000	0.05	$714	
PERIODIC COST	50	$15,000	$15,000	0.03	$509	
		$7,000,000			$4,605,444	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$4,610,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Alternative:	**Alternative 4**	**COST ESTIMATE SUMMARY**	
	Offsite Disposal, Regrade, and ARAR-Appropriate		
Name:	**Cover**		

Site:	Eagle Zinc	**Description:**	Offsite Solidification and Disposal for residue piles NP-14, RR1-3 and MP1-21. Regrade 20 acre area for onsite consolidation and cover construction. Excavate residue piles and soil and place in consolidation area. Construct 1 foot thick soil cover over consolidation area and an additional 15 acre area in southwest portion of site. Institutional controls include deed notices describing the residue and soil contamination and restrictions on site use and soil excavation.
Location:	Hillsboro, Illinois		
Phase:	TM 2 Feasibility Study		
Base Year:	2006		
Date:	8/2/2006 15:33		

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Site Development Plan	1	LS	$15,000	$15,000	
Predesign Investigations					
Survey site	1	LS	$30,000	$30,000	
Leaching Investigation	1	LS	$20,000	$20,000	
SUBTOTAL				$50,000	
Site Preparation					
Silt Fencing	4,400	FT	$3.23	$14,231	MEANS 18 05 0206
Clear and Grub all Excavation and Consolidation Area	7.0	AC	$7,769	$54,382	MEANS 17 01 0106; 20% of area requires clearing.
Residue Excavation (to Prepare Consolidation Area)	3,700	CY	$5.33	$19,734	MEANS 17-03-0276
Spread and Compact	3,700	CY	$1.01	$3,721	MEANS 17-03-0517
SUBTOTAL				$92,069	
Mobilization/Demobilization	5%			$4,603	
Subcontractor General Conditions	15%			$13,810	
SUBTOTAL				$110,483	
Offsite Disposal of Leachable Residue Piles					
Soil Excavation and Truck Loading	2,100	CY	$5.33	$11,201	MEANS 17-03-0276
Transport to Landfill	18,480	MI	$2.48	$45,921	MEANS 33-19-0210
Subtitle C Landfill Treatment and Disposal	3,119	TN	$130	$405,405	Peoria Landfill Quote
TCLP Analysis	21	EA	$251	$5,275	MEANS 33-02-1701; TCLP samples = 1/ 100 cy
SUBTOTAL				$467,802	
Mobilization/Demobilization	5%			$23,390	
SUBTOTAL				$491,192	
Excavate Piles and Soil and Consolidate					
Residue and Soil Excavation and Truck Loading	41,960	CY	$5.33	$223,799	MEANS 17-03-0276
Residue and Soil Haul to Consolidation Area	771	MI	$2.48	$1,916	MEANS 33-19-0210
SUBTOTAL				$225,715	
Mobilization/Demobilization	5%			$11,286	
Subcontractor General Conditions	25%			$56,429	
SUBTOTAL				$293,429	
Cover Construction (20 Acre Area)					
Rough Grading	96,800	SY	$4.96	$479,890	MEANS 17 03 0101
Fine Grading	96,800	SY	$0.46	$44,147	MEANS 17 03 0103
Low Permeability Clay Layer (6-inches thick)	16,133	CY	$22.15	$357,310	MEANS 17 03 0428
Vegetation Layer (6-inches thick	16,133	CY	$37.20	$600,177	MEANS 18-05-0301
Seeding Vegetation Cover	20	AC	$4,846	$96,915	MEANS 18-05-0402
SUBTOTAL				$1,578,440	
Mobilization/Demobilization	5%			$78,922	
Subcontractor General Conditions	15%			$236,766	
SUBTOTAL				$1,894,128	
Soil/Residue Verification Sampling	1	LS	$50,000	$50,000	
SUBTOTAL				$2,900,000	
Contingency	25%			$725,000	10% Scope + 15% Bid
SUBTOTAL				$3,625,000	
Project Management	5%			$181,250	USEPA 2000, p. 5-13, $2M-$10M
Remedial Design	8%			$290,000	USEPA 2000, p. 5-13, $2M-$10M
Construction Management	6%			$217,500	USEPA 2000, p. 5-13, $2M-$10M
SUBTOTAL				$688,750	
TOTAL CAPITAL COST				**$4,300,000**	

Alternative: **Alternative 4**
Offsite Disposal, Regrade, and ARAR-Appropriate Cover
Name:

COST ESTIMATE SUMMARY

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Cover Inspection and Repair					
Cover Annual Inspection	4	Hr	$100	$400	
Cover Repair	1	LS	$18,941	$18,941	Assumes 1% of area repaired
Habitat Survey					
Labor	16	HR	$100	$1,600	
Travel	1	LS	$200	$200	
Groundwater, Surface Water, and Sediment Sampling					
Groundwater and Surface Water Sample	8	LS	$186	$1,485	MEANS 33-02-1701; 4 GW + 4 SW
QC Samples	2	LS	$93	$186	MEANS 33-02-1701
Sediment Sample Metal Analysis	4	LS	$148	$591	MEANS 33-02-171C; 10 metals/sample
QC Samples	1	LS	$148	$148	
Groundwater, Surface Water and					
Labor	48	HRS	$100	$4,800	2 person crew
Equipment - meters	1	LS	$1,200	$1,200	
Consumables	1	LS	$200	$200	
Travel	1	LS	$400	$400	
Data Validation	7.5	HRS	$100	$750	
Reporting	40	HRS	$100	$4,000	
SUBTOTAL				$34,900	
Allowance for Misc Items	20%			$6,980	
SUBTOTAL				$41,880	
Contingency	25%			$10,470	10% Scope + 15% Bid
SUBTOTAL				$52,350	
Project Management	5%			$2,618	
Technical Support	10%			$5,235	
TOTAL ANNUAL O&M COST				**$60,000**	

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$15,000	$15,000	
5 year Review	10	1	LS	$15,000	$15,000	
5 year Review	15	1	LS	$15,000	$15,000	
5 year Review	20	1	LS	$15,000	$15,000	
5 year Review	25	1	LS	$15,000	$15,000	
5 year Review	30	1	LS	$15,000	$15,000	
5 year Review	35	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	45	1	LS	$15,000	$15,000	
5 year Review	50	1	LS	$15,000	$15,000	
				Total	$170,000	
TOTAL ANNUAL PERIODIC COST					**$170,000**	

PRESENT VALUE ANALYSIS

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
CAPITAL COST	0	$4,300,000	$4,300,000	1.000	$4,300,000	
ANNUAL O&M COST	1 to 50	$3,000,000	$60,000	13.8	$828,045	
PERIODIC COST	5	$15,000	$15,000	0.71	$10,695	
PERIODIC COST	10	$15,000	$15,000	0.51	$7,625	
PERIODIC COST	15	$15,000	$15,000	0.36	$5,437	
PERIODIC COST	20	$15,000	$15,000	0.26	$3,876	
PERIODIC COST	25	$15,000	$15,000	0.18	$2,764	
PERIODIC COST	30	$15,000	$15,000	0.13	$1,971	
PERIODIC COST	35	$15,000	$15,000	0.09	$1,405	
PERIODIC COST	40	$15,000	$15,000	0.07	$1,002	
PERIODIC COST	45	$15,000	$15,000	0.05	$714	
PERIODIC COST	50	$15,000	$15,000	0.03	$509	
		$7,500,000			$5,164,042	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$5,160,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Alternative: **Alternative 5**
Offsite Disposal of Residue Piles, Regrade, ARAR-Appropriate Cover Over Residue and In Situ Groundwater Treatment

Name:

COST ESTIMATE SUMMARY

Site: Eagle Zinc
Location: Hillsboro, Illinois
Phase: TM 2 Feasibility Study
Base Year: 2006
Date: 8/2/2006 15:33

Description: Offsite Solidification and Disposal for residue piles NP-14, RR1-3 and MP1-21
Excavate residue piles and soil and dispose offsite in Subtitle D landfill.
Regrade 34 acre area for cover construction
Construct 1 foot thick soil cover over 34 acre area.
Institutional controls include deed notices describing the residue and soil contamination and restrictions on site use and soil excavation.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Site Development Plan	1	LS	$15,000	$15,000	
Predesign Investigations					
Survey site	1	LS	$30,000	$30,000	
Leaching Investigation	1	LS	$20,000	$20,000	
PRB media selection study	1	LS	$50,000	$50,000	
SUBTOTAL				$100,000	
Site Preparation					
Silt Fencing	4,400	FT	$3.23	$14,231	MEANS 18 05 0206
Clear and Grub all Excavation and Cover Areas	7	AC	$7,769	$52,829	MEANS 17 01 0106; 20% of area requires clea
Residue Excavation (to Prepare Consolidation Area)	3,700	CY	$5.33	$19,734	MEANS 17-03-0276
Spread and Compact	3,700	CY	$1.01	$3,721	MEANS 17-03-0517
SUBTOTAL				$90,515	
Mobilization/Demobilization	5%			$4,526	
Subcontractor General Conditions	25%			$22,629	
SUBTOTAL				$117,670	
Offsite Disposal of Leachable Residue Piles					
Soi Excavation and Truck Loading	2,100	CY	$5.33	$11,201	MEANS 17-03-0276
Transport to Landfill	18,480	MI	$2.48	$45,921	MEANS 33-19-0210
Subtitle C Landfill Treatment and Disposal	3,119	TN	$130	$405,405	Peoria, Illinois Landfill Quote
TCLP Analysis	21	EA	$251	$5,275	MEANS 33-02-1701; TCLP samples = 1/ 100 c
SUBTOTAL				$467,802	
Mobilization/Demobilization	5%			$23,390	
SUBTOTAL				$491,192	
Offsite Disposal of Residue Piles and Soil					
Residue and Soil Excavation and Truck Loading	42,128	CY	$5.33	$224,695	MEANS 17-03-0276
Residue and Soil Haul to SUbtitle D Landfill	30,845	MI	$2.48	$76,648	MEANS 33-19-0210
Subtitle D Landfill Disposal	62,311	TN	$18	$1,121,591	Litchfield, Illinois Landfill Quote
SUBTOTAL				$1,422,933	
Mobilization/Demobilization	5%			$71,147	
SUBTOTAL				$1,494,080	
Cover Construction (34 Acre Area)					
Rough Grading	164,560	SY	$4.96	$815,814	MEANS 17 03 0101
Fine Grading	164,560	SY	$0.46	$75,050	MEANS 17 03 0103
Low Permeability Clay Layer (6-inches thick)	27,427	CY	$22.15	$607,427	MEANS 17 03 0428
Vegetat on Layer (6-inches thick)	27,427	CY	$37.20	$1,020,301	MEANS 18-05-0301
Seeding Vegetation Cover	34	AC	$4,846	$164,756	MEANS 18-05-0402
SUBTOTAL				$2,683,348	
Mobilization/Demobilization	5%			$134,167	
Subcontractor General Conditions	15%			$402,502	
SUBTOTAL				$3,220,017	
Permeable Reactive Barrier					
Security Fencing	1	LS	$6,000	$6,000	
Reactive Media Characterization Sampling	2	EA	$500	$1,000	
Continuous Trenching and Reactive Media Placemer	45,000	SF	$17	$765,000	DeWind Quote
Reactive Media	1,111	CY	$120	$133,333	MEANS 33-06-1033
Geotextile and Placement	3,000	LF	$5	$15,000	DeWind Quote
Excavated Soil Disposal as Nonhazardous	2,191	TN	$18	$39,444	Litchfiels LF quote
Excavated Soil Transport to LF	974	MI	$2.48	$2,420	MEANS 33-19-0210
Reactive Media Delivery	1,111	CY	$5.00	$5,556	
Backfill Clay	206	CY	$30.35	$6,244	MEANS 17 03 0428
Plastic under Soil Stockpile	1	LS	$500	$500	
Fine Grading	10,000	SY	$0.46	$4,561	MEANS 17-03-0106
Seeding Vegetation	1	AC	$4,846	$4,846	MEANS 18-05-0402
SUBTOTAL				$983,904	
Mobilization/Demobilization	5%			$49,195	
Subcontractor General Conditions	15%			$147,586	
SUBTOTAL				$1,180,685	
Soil/Residue Verification Sampling	1	LS	$50,000	$50,000	

Alternative: **Alternative 5**
Offsite Disposal of Residue Piles, Regrade, ARAR-Appropriate Cover Over Residue and In Situ Groundwater Treatment

Name:

COST ESTIMATE SUMMARY

SUBTOTAL		$6,670,000	
Contingency	25%	$1,667,500	10% Scope + 15% Bid
SUBTOTAL		$8,337,500	
Project Management	5%	$416,875	USEPA 2000, p. 5-13, $2M-$10M
Remedial Design	8%	$667,000	USEPA 2000, p. 5-13, $2M-$10M
Construction Management	6%	$500,250	USEPA 2000, p. 5-13, $2M-$10M
SUBTOTAL		$1,584,125	
TOTAL CAPITAL COST		**$9,900,000**	

OPERATIONS AND MAINTENANCE COST

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Cover Inspection and Repair					
Cover Annual Inspection	4	Hr	$100	$400	
Cover Repair	1	LS	$32,200	$32,200	Assumes 1% of area repaired
Habitat Survey					
Labor	16	HR	$100	$1,600	
Travel	1	LS	$200	$200	
Groundwater, Surface Water, and Sediment Sampling					
Groundwater and Surface Water Sample	8	LS	$186	$1,485	MEANS 33-02-1701; 4 GW + 4 SW
QC Samples	2	LS	$93	$186	MEANS 33-02-1701
Sediment Sample Metal Analysis	4	LS	$148	$591	MEANS 33-02-1710; 10 metals/sample
QC Samples	1	LS	$148	$148	
Groundwater, Surface Water and					
Labor	48	HRS	$100	$4,800	2 person crew
Equipment - meters	1	LS	$1,200	$1,200	
Consumables	1	LS	$200	$200	
Travel	1	LS	$400	$400	
Data Validation	7.5	HRS	$100	$750	
Reporting	40	HRS	$100	$4,000	
SUBTOTAL				$48,159	
Allowance for Misc. Items	20%			$9,632	
SUBTOTAL				$57,791	
Contingency	25%			$14,448	10% Scope + 15% Bid
SUBTOTAL				$72,238	
Project Management	5%			$3,612	
Technical Support	10%			$7,224	
TOTAL ANNUAL O&M COST				**$83,000**	

Alternative: **Alternative 5**
Offsite Disposal of Residue Piles, Regrade, ARAR-*Appropriate Cover Over* Residue and In Situ Groundwater Treatment

COST ESTIMATE SUMMARY

Name:

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$15,000	$15,000	
5 year Review	10	1	LS	$15,000	$15,000	
5 year Review	15	1	LS	$15,000	$15,000	
5 year Review	20	1	LS	$15,000	$15,000	
5 year Review	25	1	LS	$15,000	$15,000	
5 year Review	30	1	LS	$15,000	$15,000	
5 year Review	35	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	40	1	LS	$15,000	$15,000	
5 year Review	45	1	LS	$15,000	$15,000	
5 year Review	50	1	LS	$15,000	$15,000	
				Total	$170,000	
TOTAL ANNUAL PERIODIC COST					**$170,000**	

PRESENT VALUE ANALYSIS

Discount Rate : 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
CAPITAL COST	0	$9,900,000	$9,900,000	1.000	$9,900,000	
ANNUAL O&M COST	*1 to 50*	*$4,150,000*	*$83,000*	*13.8*	*$1,145,462*	
PERIODIC COST	5	$15,000	$15,000	0.71	$10,695	
PERIODIC COST	10	$15,000	$15,000	0.51	$7,625	
PERIODIC COST	15	$15,000	$15,000	0.36	$5,437	
PERIODIC COST	20	$15,000	$15,000	0.26	$3,876	
PERIODIC COST	25	$15,000	$15,000	0.18	$2,764	
PERIODIC COST	30	$15,000	$15,000	0.13	$1,971	
PERIODIC COST	35	$15,000	$15,000	0.09	$1,405	
PERIODIC COST	40	$15,000	$15,000	0.07	$1,002	
PERIODIC COST	45	$15,000	$15,000	0.05	$714	
PERIODIC COST	50	$15,000	$15,000	0.03	$509	
		$14,200,000			$11,081,459	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$11,080,000**	

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

TABLE QTY-1
Estimated Quantities Calculations
Eagle Zinc
Hillsboro, Illinois
TM 2 Feasibility Study

Description of Quantity

Estimated Quantities for:	**Alternative 2**	
Silt Fencing Consolidation Area	2,000	FT
Silt Fencing Excavation Area	5,600	FT
Clear and grub area	7	AC
Consolidation Area	5	AC
Consolidation Area	24,200	SY
Regrade volume Requiring excavation and relocatior	3,700	CY
Imobilization In Situ Volume	2,100	CY
Imobilization Ex Situ Volume	2,310	CY
Sulfide Reagent for Immobilization	187,110	LB
Mileage for reagent delivery	4,678	MI
Residue Pile In situ Excavation Volume	41,400	CY
Residue Pile Ex Situ Volume	45,540	CY
Soil In Situ Volume > PRGs	560	CY
Soil Ex Situ Volume > PRGs	728	CY
Average trucking distance to consolidation area	0.25	MI
Trucking distance to consolidation area	771	MI
Soil Cover clay	4,033	CY
Soil Cover topsoil	4,033	CY
Groundwater samples	4	EA
Surface water samples	4	EA
Sediment samples	4	EA
Add'l Estimated Quantities for:	**Alternative 3**	
Silt Fencing 20 Acre Cover Area	4,400	FT
Cover Area	20	AC
Cover Area	96,800	SY
Soil Cover clay	16,133	CY
Soil Cover topsoil	16,133	CY
Leachable COC Residue Piles In Situ Volume	2,100	CY
Leachable COC Residue Piles Ex Situ Volume	2,310	CY
Cap Area	1,260	SY
Cap Area	11,340	SF
Clay Layer Volume	840	CY
Drainage Layer Volume	420	CY
Freeze-Thaw Layer Volume	630	CY
Vegetation Layer Volume	210	CY
Add'l Estimated Quantities for:	**Alternative 4**	
Leachable COC Residue Piles In Situ Volume	2,100	CY
Leachable COC Residue Piles Ex Situ Volume	2,310	CY
Leachable COC Residue Piles Ex Situ Volume	3,119	TN
One-Way Miles to Subtitle C Landfill	18,480	MI
Cover Area	20	AC
Cover Area	96,800	SY
Soil Cover clay	16,133	CY
Soil Cover topsoil	16,133	CY
Add'l Estimated Quantities for:	**Alternative 5**	
One-Way Miles to Subtitle C Landfill	18,480	MI
Residue Pile In situ Excavation Volume	41,400	CY
Residue Pile Ex Situ Volume	45,540	CY
Soil In Situ Volume > PRGs	560	CY
Soil Ex Situ Volume > PRGs	728	CY
Residue and Soil Weight	62,311	TN
One-Way Miles to Subtitle D Landfill	30,845	MI
Cover Area	34	AC
Cover Area	164,560	SY
Soil Cover clay	27,427	CY
Soil Cover topsoil	27,427	CY
Reactive Barrier Wall Length	3,000	LF
Reactive Barrier Wall Area	45,000	SF
Reactive Barrier Wall Grading Area	10,000	SY
Reactive Barrier Wall Excavation Volume	1,667	CY
Reactive Barrier Wall- Reactive Media Thickness	10	FT
Reactive Barrier Wall- Reactive Media Volume	1,111	CY
Reactive Barrier Wall- Clay Backfill Volume	206	CY
Reactive Barrier Wall- Geotextile Area	6,667	SY
Reactive Barrier Wall- Seeding Vegetation	1	AC
Excavated Soil Disposal (soil not used as backfill)	2,191	TN
One-Way Miles to Subtitle D Landfil	974	MI

Unit Costs Derived from Means Unit Prices
Eagle Zinc
Hillsboro, Illinois
TM 2 Feasibility Study

Means Category	Description	Units	Labor			Equipment			Materials	Subtotal	Local Cost Factor (b)
			Unadjusted Cost	Productivity Factor (a)	Adjusted Cost	Unadjusted Cost	Productivity Factor	Adjusted Cost	Cost		
ENVIRONMENTAL REMEDIATION COST DATA - UNIT PRICE (Ref. 1)											
17-01-0106	Clear and Grub Heavy brush and Light Trees	AC	$2,947.00	82%	$3,593.90	$2,684.00	100%	$2,684.00	$0.00	$6,277.90	0.99
17-03-0101	Rough Grading	SY	$1.03	82%	$1.26	$2.75	100%	$2.75	$0.00	$4.01	0.99
17-03-0106	Fine Grading	SY	$0.13	82%	$0.16	$0.21	100%	$0.21	$0.00	$0.37	0.99
17-03-0276	Excavation, 1 Cy Hydraulic Excavator, Med. Mat'l, 40 CY/HR	CY	$1.64	82%	$2.00	$2.31	100%	$2.31	$0.00	$4.31	0.99
17-03-0281	Borrow Subgrade, Load and Haul and Spread	CY	$2.31	82%	$2.82	$3.91	100%	$3.91	$0.00	$6.73	0.99
17-03-0423	Backfill with Offsite Borrow, 6" Lifts, Spreading, Compaction	CY	$1.08	82%	$1.32	$2.27	100%	$2.27	$6.08	$9.67	0.99
17-03-0426	Sand, 6-inch lifts, Offsite	CY	$1.09	82%	$1.33	$2.04	100%	$2.04	$8.50	$11.87	0.99
17-03-0428	Clay, 6-inch lifts, Offsite	CY	$3.22	82%	$3.93	$6.15	100%	$6.15	$7.82	$17.90	0.99
17-03-0602; 02250	Roller, grader- cement stabilization	CY	$0.77	82%	$0.94	$1.80	100%	$1.80	$0.00	$2.74	0.99
18-05-0206	Silt Fence	LF	$1.52	82%	$1.85	$0.00	100%	$0.00	$0.76	$2.61	0.99
18-05-0301	Topsoil, 6" Lifts, Offsite	CY	$4.38	82%	$5.34	$3.12	100%	$3.12	$21.60	$30.06	0.99
18-05-0402	Seeding, Vegetative Cover	AC	$73.13	82%	$89.18	$56.58	100%	$56.58	$3,770.00	$3,915.76	0.99
33-02-1701	TCLP Metal Analysis	EA	$0.00	82%	$0.00	$0.00	100%	$0.00	$203.00	$203.00	0.99
33-02-1710	Metal Analysis, per metal	EA	$0.00	82%	$0.00	$0.00	100%	$0.00	$11.93	$11.93	0.99
33-02-0508	Metals Analysis	EA	$0.00	82%	$0.00	$0.00	100%	$0.00	$75.00	$75.00	0.99
33-19-0210	Dump Truck Transportation HW, 200-299 Miles	MI	$0.00	82%	$0.00	$0.00	100%	$0.00	$2.51	$2.51	0.99
33-08-0507	Clay 10E-7, 6" Lifts, Off-site	CY	$5.61	82%	$6.84	$9.57	100%	$9.57	$8.11	$24.52	0.99
33-08-0531	6 oz/sy Geotextile	SY	$0.46	82%	$0.56	$0.02	100%	$0.02	$0.79	$1.37	0.99
33-08-0571	40 Mil HDPE Liner	SF	$0.97	82%	$1.18	$0.17	100%	$0.17	$0.32	$1.67	0.99
33-15-0406	Portland Cement - Bulk	TN	$0.00	82%	$0.00	$0.00	100%	$0.00	$120.00	$120.00	0.99
33-19-7270	Landfill Nonhazardous Waste Disposal	CY	$0.00	82%	$0.00	$0.00	100%	$0.00	$101.00	$101.00	0.99
33-19-7265	Landfill HW Disposal Requiring Stabilization	TN	$0.00	82%	$0.00	$0.00	100%	$0.00	$351.00	$351.00	0.99
Quote	Sulfide Reagent for Onsite Immobilization	LB									
Quote	Peoria Disposal- Quote for solidification and Disposal	TN									
Quote	Litchfield Landfill - Qupote for Disposal of special waste	TN									
Quote	Peoria Disposal- Quote for bulk transport	TN									

NOTES:

(a) Productivity factor of 82% applied to labor unit costs for level D health and Safety where applicable. See Ref. 1 for details.
(b) Local cost factor of 0.99 applied for Hillsoboro, Illinois. See Ref. 1 for details.
(c) Subcontractor overhead (15%) and profit (10%) included in unit cost were applicable. See Ref 2 for details.
(d) 2004 costs updated to 2006 by 8%.

REFERENCES:

1. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA.
2. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

Unit Costs Derived from Means Unit Prices
Eagle Zinc
Hillsboro, Illinois
TM 2 Feasibility Study

Means Category	Description	Units	Subtotal	Contractor Mark-Up Overhead	Contractor Mark-Up Profit	Estimated Unit Cost
ENVIRONMENTAL REMEDIATION COST DATA - UNIT PRICE (Ref. 1)						
17-01-0106	Clear and Grub Heavy brush and Light Trees	AC	$6,215.12	15%	10%	$7,769
17-03-0101	Rough Grading	SY	$3.97	15%	10%	$4.96
17-03-0106	Fine Grading	SY	$0.36	15%	10%	$0.46
17-03-0276	Excavation, 1 Cy Hydraulic Excavator, Med. Mat'l, 40 CY/HR	CY	$4.27	15%	10%	$5.33
17-03-0281	Borrow Subgrade, Load and Haul and Spread	CY	$6.66	15%	10%	$8.32
17-03-0423	Backfill with Offsite Borrow, 6" Lifts, Spreading, Compaction	CY	$9.57	15%	10%	$11.96
17-03-0426	Sand, 6-inch lifts, Offsite	CY	$11.75	15%	10%	$14.69
17-03-0428	Clay, 8-inch lifts, Offsite	CY	$17.72	15%	10%	$22.15
17-03-0602; 02250	Roller, grader- cement stabilization	CY	$2.71	15%	10%	$3.39
18-05-0206	Silt Fence	LF	$3	15%	10%	$3.23
18-05-0301	Topsoil, 6" Lifts, Offsite	CY	$30	15%	10%	$37.20
18-05-0402	Seeding, Vegetative Cover	AC	$3,877	15%	10%	$4,846
33-02-1701	TCLP Metal Analysis	EA	$201	15%	10%	$251
33-02-1710	Metal Analysis, per metal	EA	$12	15%	10%	$15
33-02-0508	Metals Analysis	EA	$74	15%	10%	$93
33-19-0210	Dump Truck Transportation HW, 200-299 Miles	MI	$2.48	0%	0%	$2.48
33-08-0507	Clay 10E-7, 6" Lifts, Off-site	CY	$24.28	15%	10%	$30.35
33-08-0531	6 oz/sy Geotextile	SY	$1.36	15%	10%	$1.70
33-08-0571	40 Mil HDPE Liner	SF	$1.66	15%	10%	$2.07
33-15-0406	Portland Cement - Bulk	TN	$118.80	15%	10%	$149
33-19-7270	Landfill Nonhazardous Waste Disposal	CY	$99.99	0%	0%	$100
33-19-7265	Landfill HW Disposal Requiring Stabilization	TN	$347.49	0%	0%	$347
Quote	Sulfide Reagent for Onsite Immobilization	LB				$ 0.075
Quote	Peoria Disposal- Quote for solidification and Disposal	TN				$ 130
Quote	Litchfield Landfill - Qupote for Disposal of special waste	TN				$ 18
Quote	Peoria Disposal- Quote for bulk transport	TN				$ 40

NOTES:
(a) Productivity factor of 82% applied to labor unit costs for level D health and Safety where applicable. See Re
(b) Local cost factor of 0.99 applied for Hillsoboro, Illinois. See Ref. 1 for details.
(c) Subcontractor overhead (15%) and profit (10%) included in unit cost were applicable. See Ref 2 for details.
(d) 2004 costs updated to 2006 by 8%.

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2. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost E
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